Instrumentation for In Situ Analysis Missions III: Rock Core and Caching Technique

#1118

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Overview of In Situ Tool

- Drill (4 motors)
- Drill bit & holder (Zero actuators)
- Surface abrasion bit & holder (Zero actuators)
- Cache and sealing system (zero actuators)

No additional motors needed beyond the drill

Science Requirements

- Ability to deploy the corer to a wide range of targets away from the rover body, and against rover hazards
- Ability to drill into loose rocks, rock outcrops, and collect multiple rocky samples
- Collect granular material (regolith) and move them into a sample cache
- Sample caching and preservation
- Choose between samples – replace with higher value samples, take sacrificial samples, or deposit samples on Martian surface for later retrieval.
- Bit change-out
- Surface Abrasion Tool

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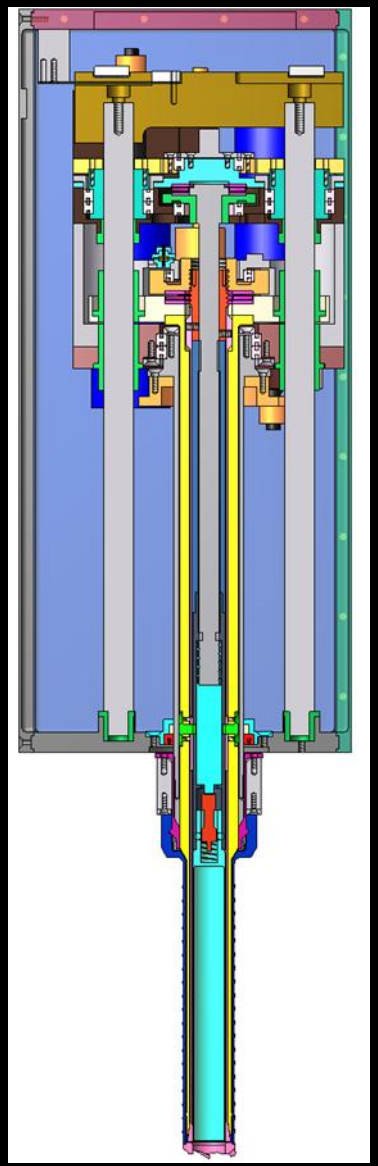
Bear Drill Capabilities

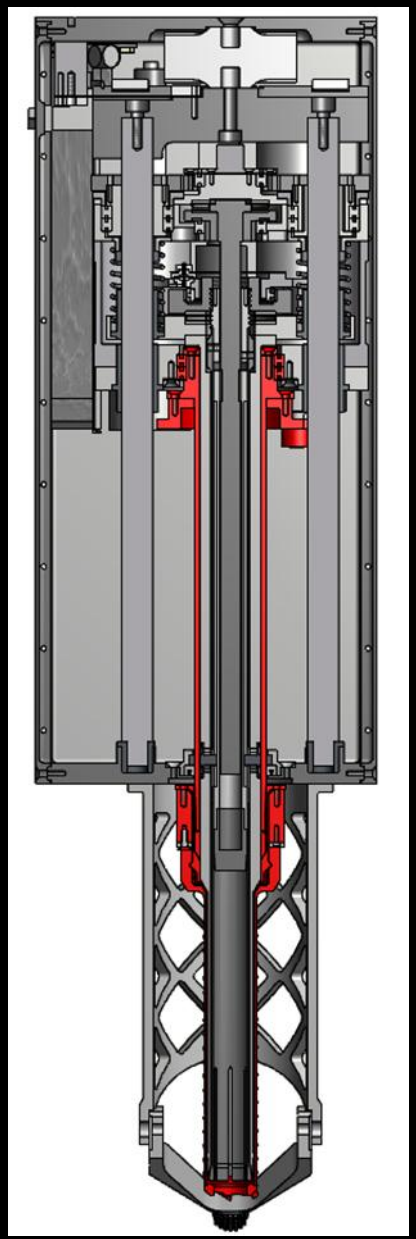
- Lower risk of core damage
- Lower risk of core becoming stuck in the drill
- Accepts sample Tubes
- Flexibility of system-easy to provide “add-on” capability with no impact to design
- Simplicity of design

The Drill

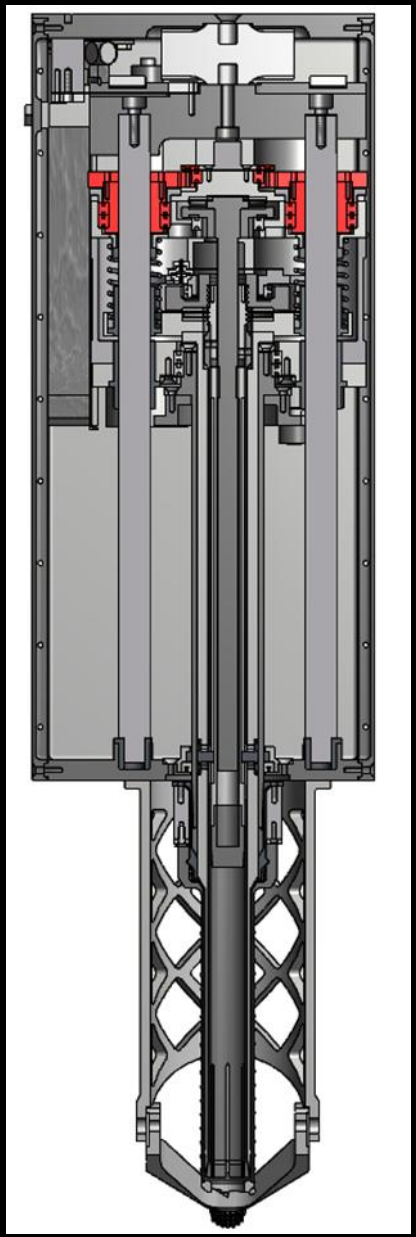


Drill Axes

Drill

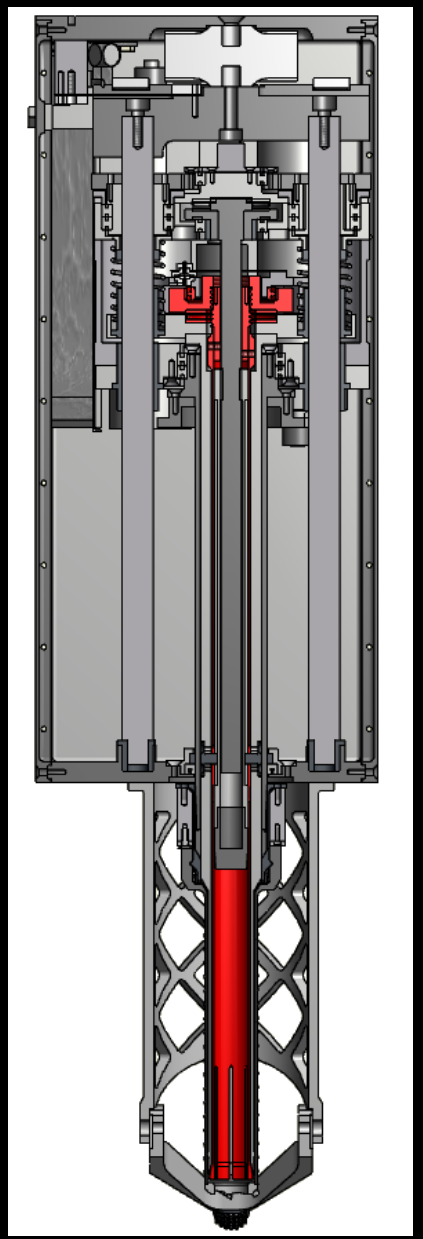


Z-Axis

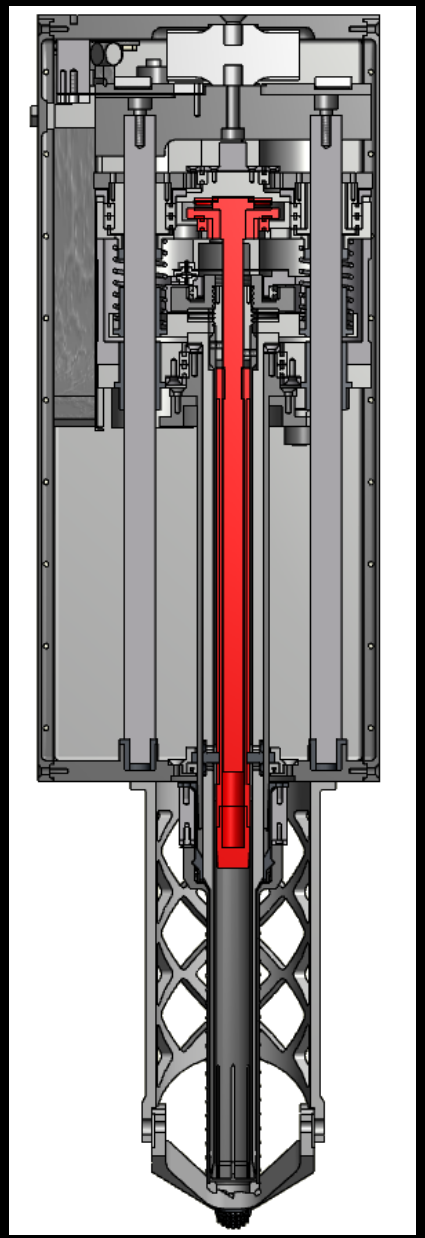


Drill Axes

Break Off



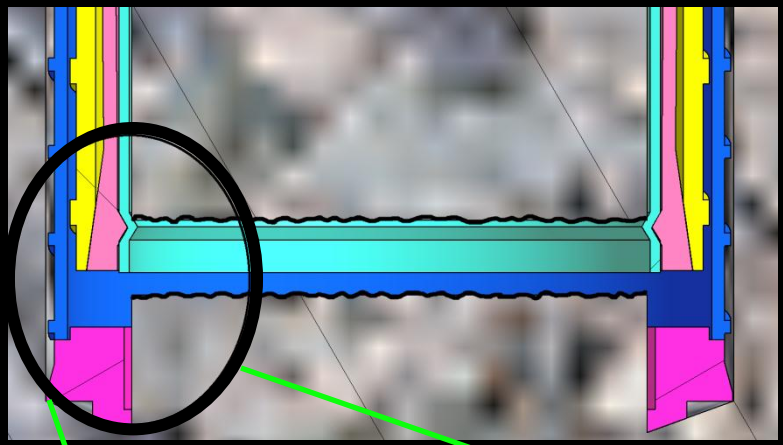
Push Rod

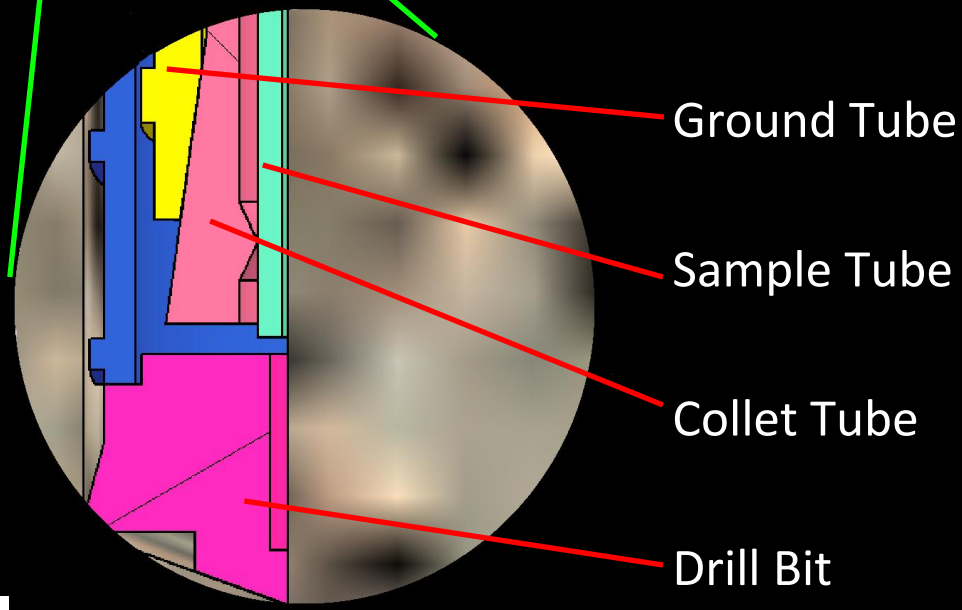


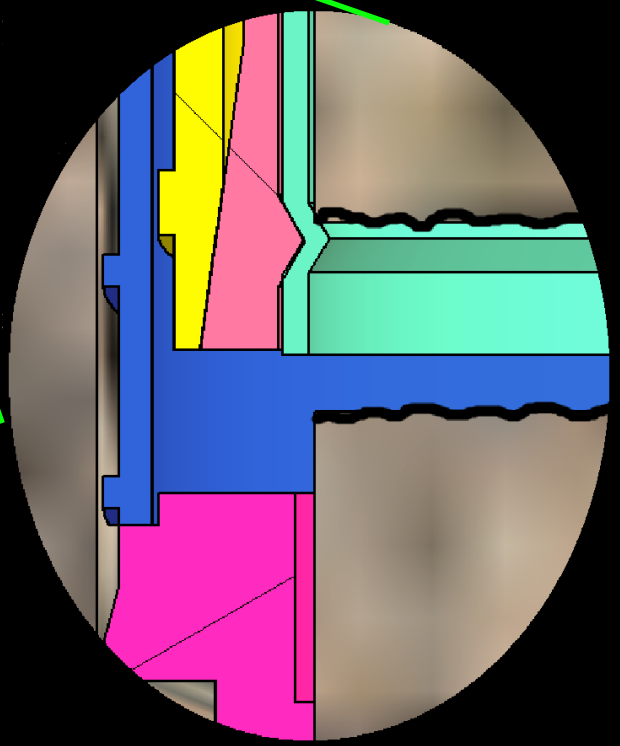
Cross Section of Drill Tip

Un-broken core

Broken core and crimped sample tube







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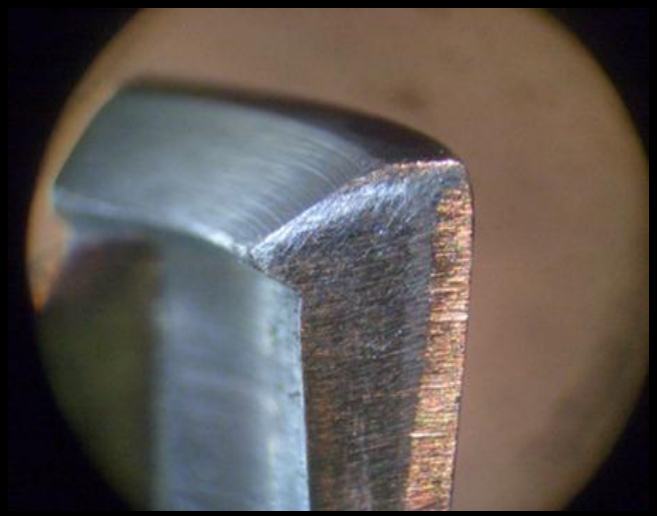
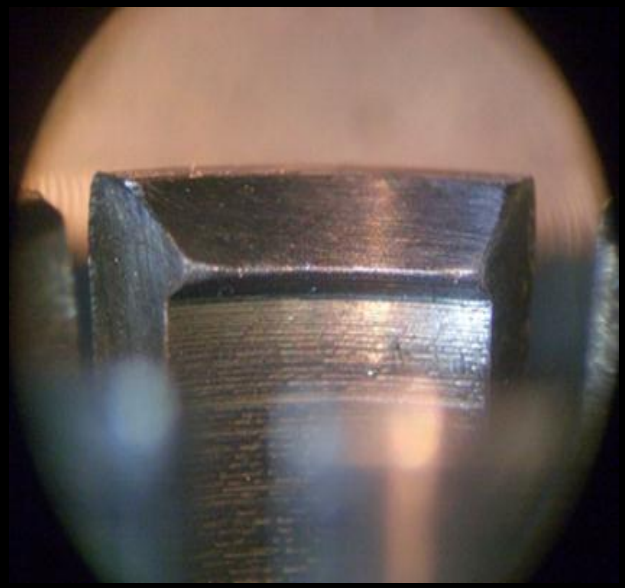
Collet Tube

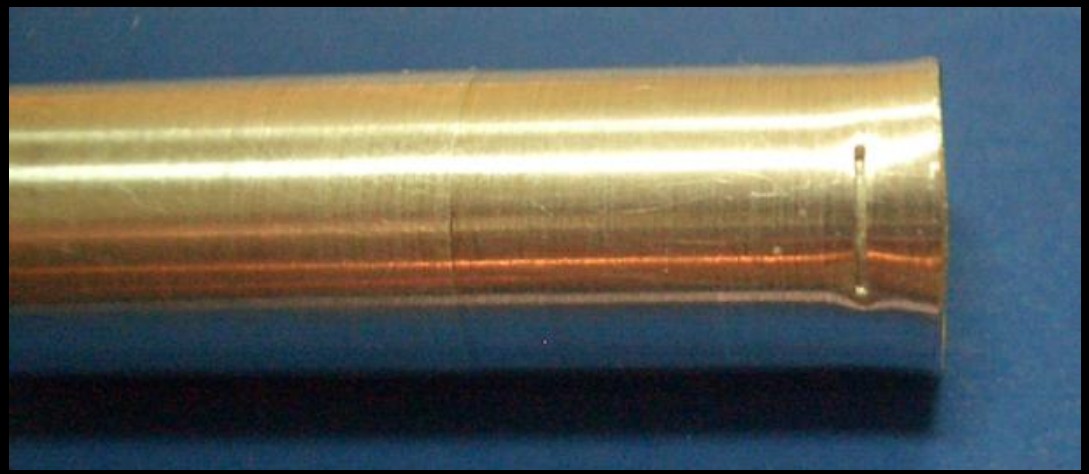
The Central Element of the Design

- Collet does not rotate with respect to core
- Collet fingers move inward/upward to break core
- Secures the core within the sample tube
- Rigidly and concentrically holds other tools
- Sensors confirm core break

Inner Teeth of Collet Tube







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Choose Between Samples

- A version of the sample tube can hold granular material (regolith)
- In absence of sample tube, a core can still be acquired, ejected and studied in situ
- Samples can be ejected onto the Martian surface for later pick up
- Samples can be replaced with higher value samples

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Sample Tube/Crimp Test

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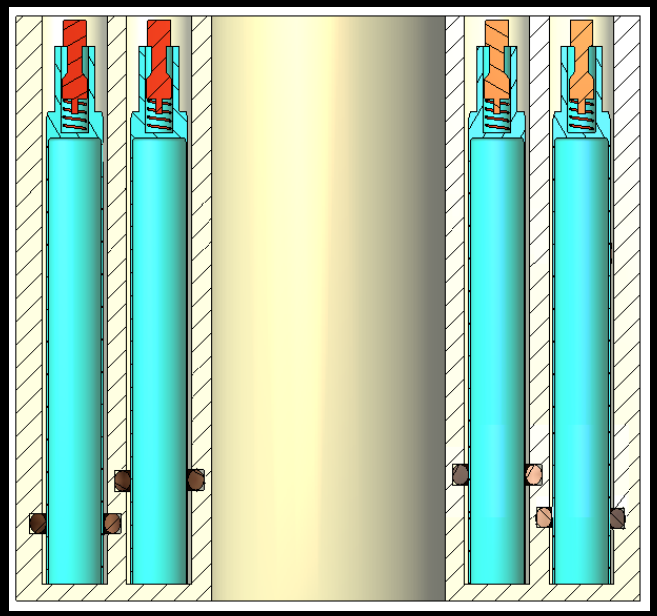
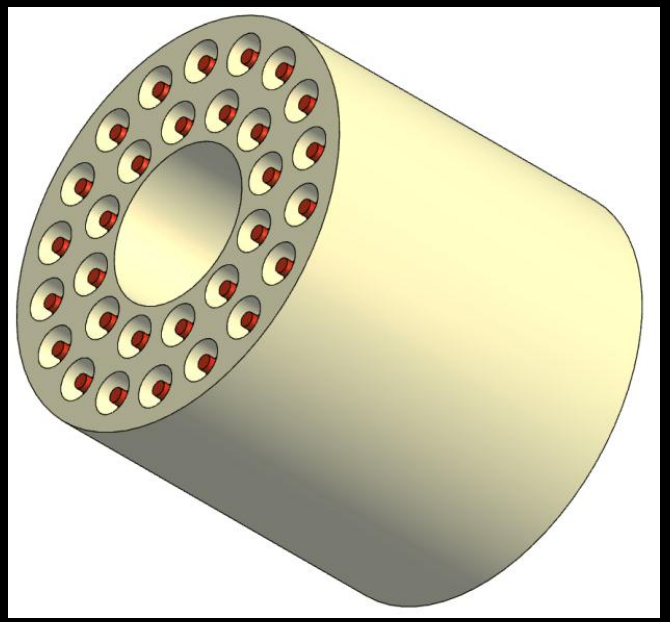
Sample Cache

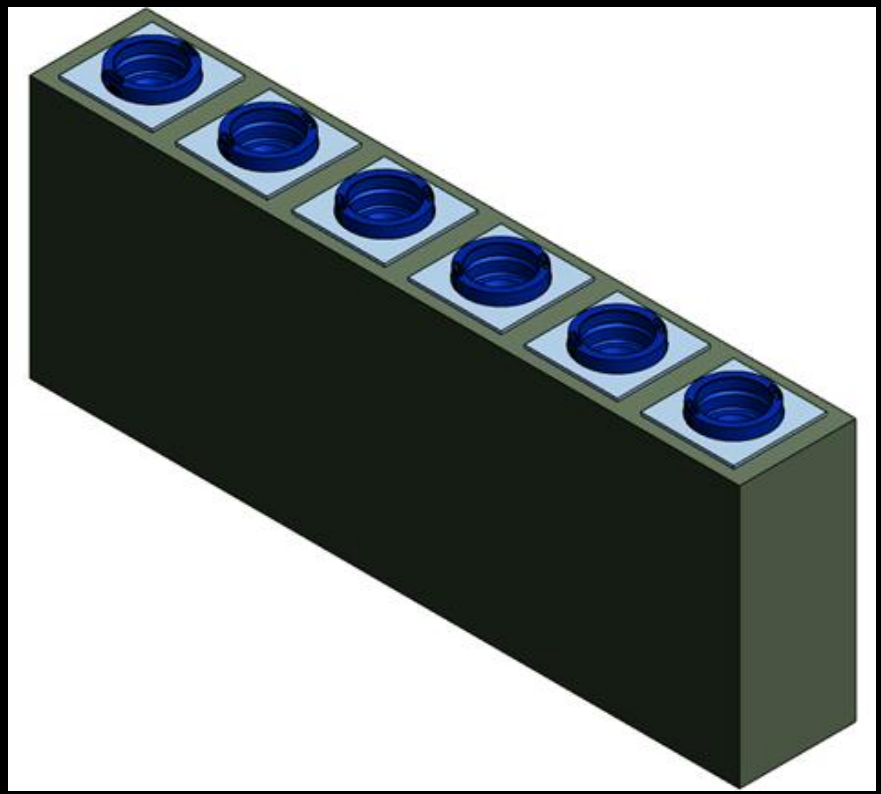
Cross section of Cache





- No sample tube caps required; cache itself acts as a cap that seals each sample tube throughout the mission

Drill Bit Holder



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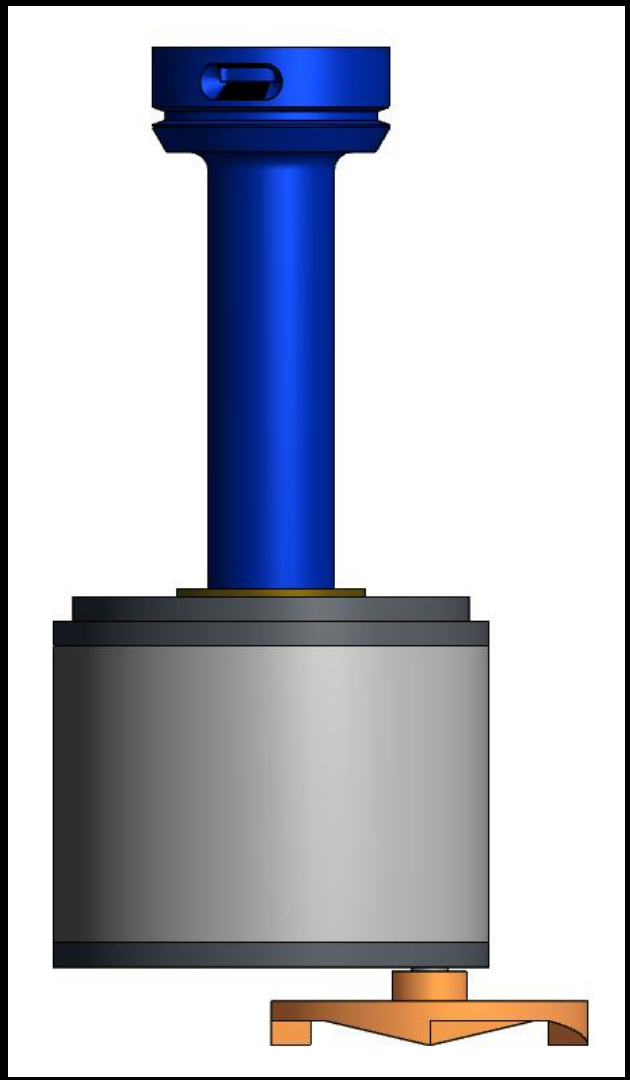
Surface Abrasion Tool



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Summary
Future Science Drill

- Must be low risk
- Ability to inspect, eject or save sample
- Flexibility of system-easy to provide “add-on” tools with no impact to design
- Simplicity of design – No additional motors-
- Versatility makes technology mission adaptable